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Installation and Operation Manual

MP MASTER
MA35380

Edwards

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INSTRUCTIONS
05-B302-01-883
MAY 1986
(Supersedes 05-B302-01-882)

E040/55 OIL VAPOUR DIFFUSION PUMP

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AMENDMENT 1
05-B302-01-883
MAY 1986
I/D 41

E040/55 OIL VAPOUR DIFFUSION PUMP

Please note. The fluid charge has been changed from 25ml to 20ml.
(See page 1 - Specifications and page 4 - Fluid filling).

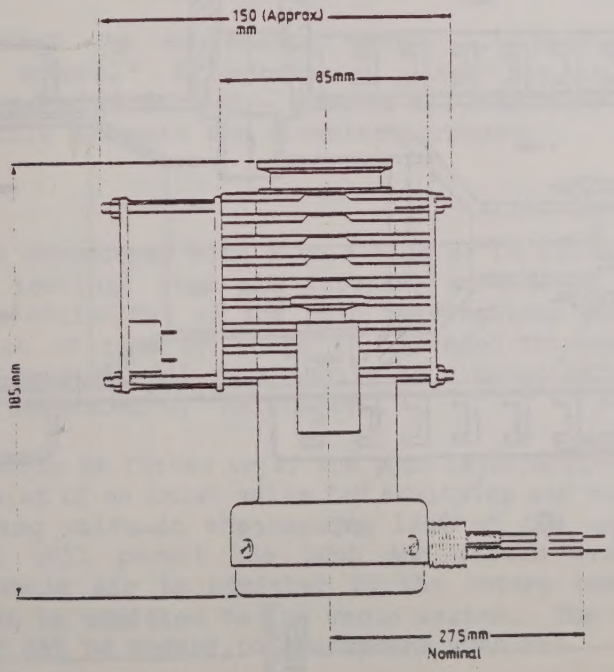
SPECIFICATION AND DATA

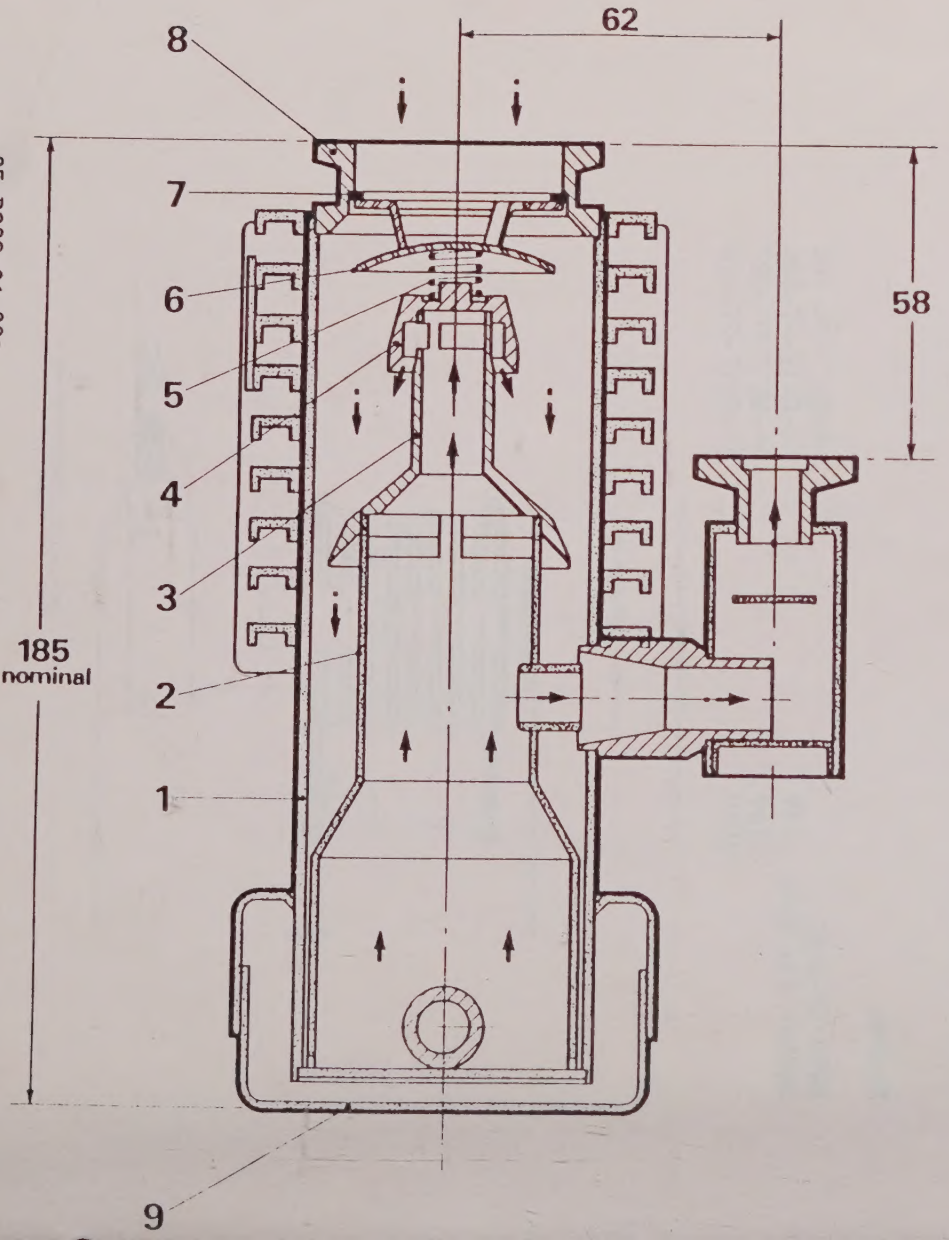
Pumping speed (air)	55 ls^{-1} (27 ls^{-1} baffled)
(hydrogen)	50 ls^{-1} (40 ls^{-1} baffled)
Ultimate vacuum	better than 7 x 10^{-7} mbar
Critical backing pressure	0.65 mbar
Fluid charge	20 ml
Recommended fluid	Edwards L9
Minimum backing pump displacement	1 $m^3 h^{-1}$
Recommended backing pump	E2M2
Heater loading	0.16 kW
Minimum cooling air flow	4.5 $m^3 h^{-1}$
Inlet connexion (Klein Flange)	NW40
Inlet seal	NW40 Co-Seal
Backing connexion (Klein Flange)	NW10
Weight	4.41b (2kg)

Product description	**Ordering number**
E040/55 diffusion pump complete with fluid charge, inlet Co-Seal, NW40 clamping ring, fan, and instructions.	
110-125V 50/60Hz	05-B302-01-110
210-225V 50/60Hz	05-B302-01-210
230-250V 50/60Hz	05-B302-0110-240
Thermo-snap switch accessory	05-B279-03-005
Edwards L9 fluid (500 ml)	09-H115-01-016

Spares

NW40 Co-Seal	08-B271-58-160
Heater (0.16kW) 110V	14-H017-07-026
210V	14-H017-07-027
240V	14-H017-07-028





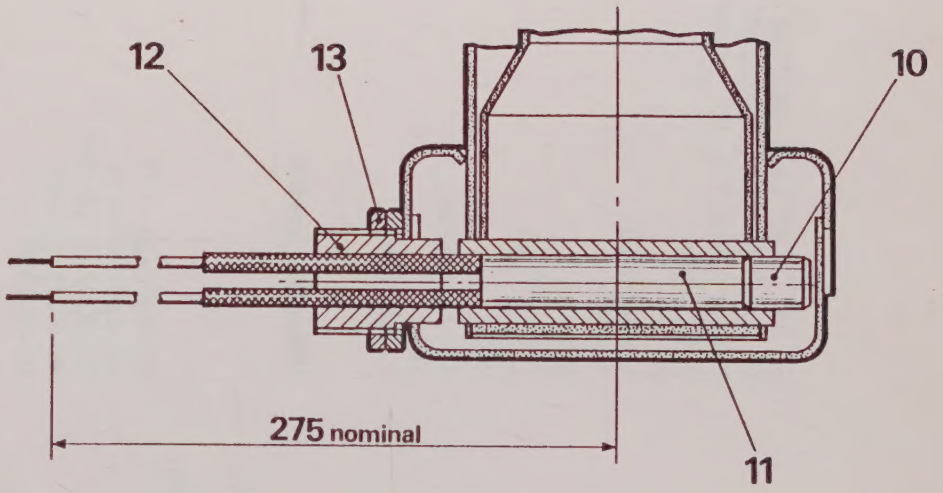


Fig.1 Model 40/55 Diffusion pump

1. Pump body
2. Pump boiler
3. Top cone
4. Top cap
5. Spring
6. Baffle assembly*
7. Circlip
8. Inlet flange (KF40)
9. Heater shield
10. Spacer
11. Heater
12. Conduit adaptor
13. Locknut

*Baffle assembly replaced by retaining bar on unbaffled versions

GENERAL DESCRIPTION

The model E040/55 is a fast warm-up, air cooled diffusion pump with flexible fan mounting capability designed for high vacuum performance at lowest capital cost. Performance can be maintained with the cooling fan mounted up to 125mm (5in)from the pump - this distance can be greatly extended if the cooling air is ducted from fan to pump. The pump is available with (or without) an integral baffle.

Construction and operation:

The pump essentially consists of a finned, air cooled body with integral backing condenser, an interior jet system and baffle. The jet system comprises top and second stage jet nozzle assemblies, and a vapour tube. The top jet is surmounted by a jet cap and the baffle is positioned in the mouth of the pump above the jet cap. In the non-baffled versions of the pump, the baffle is replaced by a retaining bar. The pump boiler is located in the base of the pump, the oil being heated and vapourised by a cartridge type heater. System and backing pump connexions are made by (NW size) Klein flanges - Edwards valves and fittings can be mounted directly on the pump.

The pump fluid in the boiler is heated and vapourised to generate a suitable boiler pressure within the jet system. The resultant vapour passes upwards through the jet stages and emerges from the jet nozzles as high velocity vapour streams to impinge and condense on the cooled pump body and subsequently drain to the boiler. Under normal operation, a portion of any gas arriving at the pump inlet (top jet) is trapped, compressed and transferred to the next stage. This process is repeated through the pump jet stages, until the gas is removed by the backing pump via the backing tube and the condenser.

INSTALLATION

Unpacking

On receipt of the equipment, remove all packing material and protective covers. If necessary, clean the inlet flange with acetone or suitable solvent - observe all necessary precautions when using volatile solvents for cleaning purposes.

General

The pump is despatched with a thin film of L9 fluid (remaining from laboratory testing) over all internal surfaces. This acts as a surface protection but if the pump has remained open to atmosphere for a period of time or if it is intended to use an alternative fluid, the existing oil film should be cleaned off with a suitable solvent as described in 'MAINTENANCE'.

When the baffle is fitted or if the pump is unbaffled, the system may simply consist of an inlet valve for admitting air to the rotary pump and a backing valve in the backing line of the vapour pump. This arrangement will permit the pump and vacuum system to be left evacuated while air is admitted to the rotary pump and will also allow air to be admitted to the whole system. The vapour diffusion pump should not be opened to atmosphere when hot.

Vacuum testing

The pump should be installed and tested for vacuum-tightness before placing fluid in the boiler as outgassing from the fluid may render subsequent testing difficult. For most purposes, it is sufficient to test the system with the rotary backing pump and to assess the overall vacuum-tightness by the closeness to which the vacuum attained at the inlet of the pump or in the apparatus, approaches the ultimate vacuum of the rotary pump. More stringent testing can be carried out to suit the operating vacuum-tightness required.

Fluid filling

The pump can be filled by pouring the required fluid charge (20ml) into the boiler via the backing spout - allow the fluid to settle prior to operating the pump. Use the recommended pump fluid -Edwards L9. Alternatively, the fluid charge can be poured via the inlet, through the baffle, and down the inner wall of the pump.

Vacuum connexions

Pump inlet:

The NW40 size inlet flange can be connected to NW40 flanged system components using the Co-seal and NW40 clamping ring supplied separately in pack Code No C105-20-303, as shown in Fig. 2a.

Backing connexion:

The NW10 flange on the backing condenser can be connected to the forepump using an NW10 size centring ring, O ring and clamping ring. (These items are available as accessories).

Electrical connexions

(i) Ensure the electrical supply voltage is as specified on the pump data plate. Connect the electrical supply to the pump heater by means of the flying leads provided; connect the earth screw (marked) on the heater shield to a suitable earth.

(ii) For rapid warm up and cooling down, the fan motor should be wired so that it is switched simultaneously with the forepump. Thus, in order to cool down the diffusion pump, the heater can be switched off whilst the cooling fan continues to operate.

(iii) A mounting plate for a thermal cut-out switch is attached to the finned pump body; this will operate to switch off the pump heater, if failure of the cooling air flow occurs.

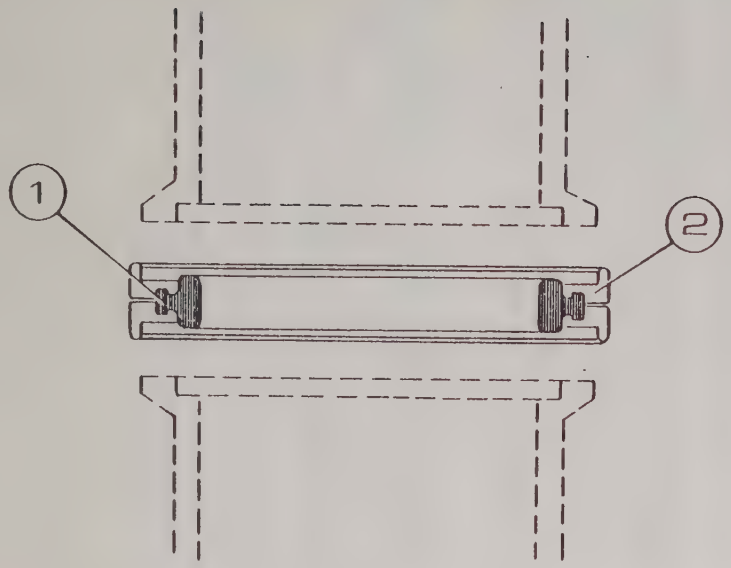


Fig. 2a
Assembly of KF40 flanged components

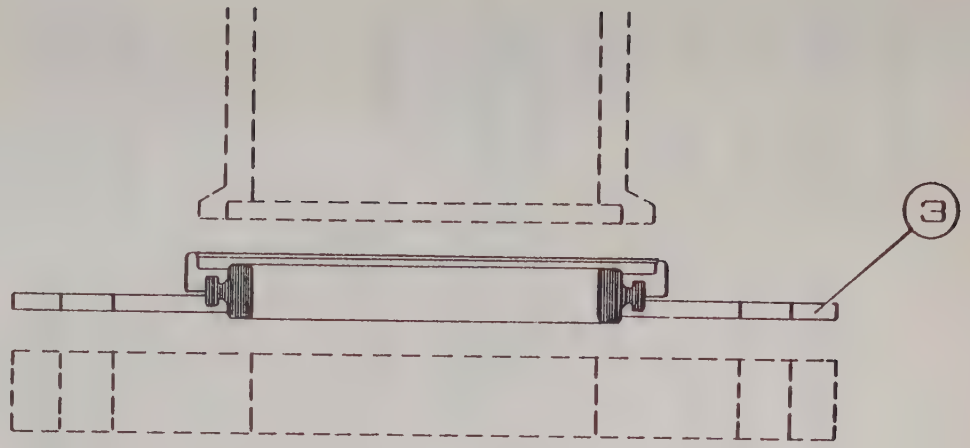


Fig.2b Assembly of KF40 flanged component to ISO40 flange

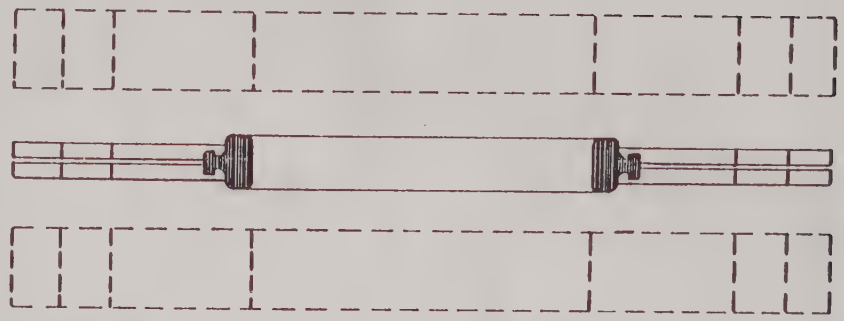
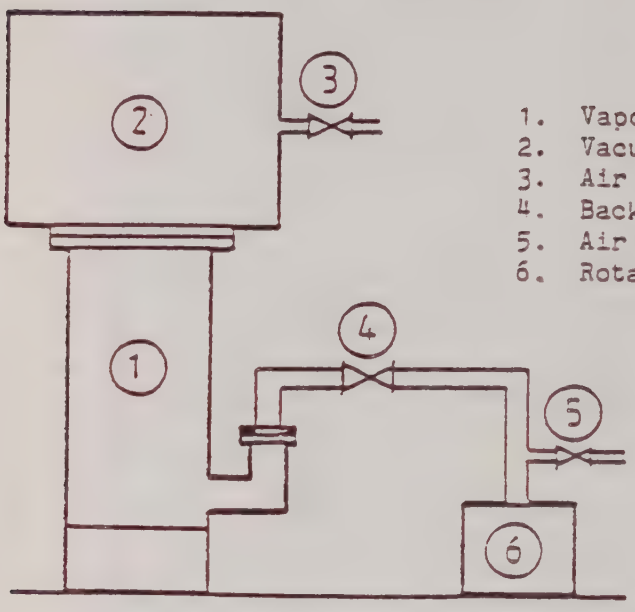


Fig.2c Assembly of ISO40 flanges

Fig.2 FLANGE SEAL PACK

OPERATION

It is assumed that the pump will operate in conjunction with a system as shown in Fig.3.



1. Vapour diffusion pump
2. Vacuum system
3. Air admittance valve (system)
4. Backing valve
5. Air admittance valve (rotary pump)
6. Rotary backing pump

Fig.3 Typical pumping system

Starting up

The following procedure is recommended when both the pump and apparatus are at atmospheric pressure:

(a) Close the air-admittance valves (if fitted) and ensure all other openings to atmosphere are closed.

(b) Open the backing valve.

(c) Switch on the rotary backing pump - the cooling fan will be switched simultaneously.

*(d) Switch on the electrical supply to the pump heater when the backing pressure reaches 0.5 mbar or better.

(e) Allow a warming up period of four to five minutes to allow the pump to reach operating temperature.

*Note: It is permissible to switch the pump heater on immediately the backing valve is opened, provided the rotary pump is capable of evacuating the apparatus to 0.5 mbar in 3 minutes or less. Ensure the pump is being cooled by the fan before the pump heater is switched on.

Closing down

(a) Switch off the diffusion pump heater and allow the pump to cool.

(b) Close the backing valve.

(c) Open the rotary pump air admittance valve and switch off the rotary pump.

Note:

This method of closing down ensures that the vapour diffusion pump is left evacuated and prevents the pump fluid from absorbing air. When starting up, subsequently, evacuate the system to a pressure of about 0.5 mbar via the backing valve.

CAUTION: Allow a minimum cooling down period of 20 minutes before handling or touching the pump boiler.

GENERAL OPERATING AND SERVICING PROCEDURE

(i) A certain amount of backstreaming will occur, i.e. a small percentage of molecules of the working fluid will suffer collisions in the jet region, causing migration into the high vacuum system. Such backstreaming is undesirable and may be reduced to minimal proportions by the baffle positioned in the pump mouth.

(ii) The pump heater should perferably be switched off and the pump allowed to cool before air is admitted, otherwise, on re-evacuation, the fluid will superheat and evolve a quantity of vapour which will pass into the backing pump. On valveless systems, the use of silicone fluid No. 702 will prolong the working periods of continuous use before fluid recharging becomes necessary.

(iii) The rotary backing pump should not be switched off unless air is admitted to the pump, otherwise, rotary pump oil may be forced into the backing line. Although the recommended backing pumps incorporate an oil 'suck-back' prevention device, it is nevertheless recommended that an air admittance valve is fitted for use when the pump is to be switched off for any length of time.

(iv) Fluid charging

An excessively hot heater may indicate that there is insufficient fluid in the pump. If the pump ceases to give satisfactory ultimate pressure in a clean leak-tight system, the fluid may be drained and inspected. If the oil is badly charred or discoloured, the pump must be dismantled and cleaned as described in para. (vii) and the fluid charge replenished as detailed in 'INSTALLATION'.

(v) Radiation Shield

The radiation shield surrounding the pump boiler should be kept clean to maintain thermal efficiency.

(vi) Dismantling

(a) Warm the pump fluid for a few minutes to assist draining.

(b) Switch off the pump heater and isolate the pump from the electrical supply.

(c) Detach the pump from the system and remove the Co-seal from the inlet flange. Drain the fluid from the boiler.

(d) Remove the circlip (7) and carefully withdraw the baffle assembly (6) and tensioned spring from the pump mouth.

(e) Detach and withdraw the top cap (4) from the pump interior.

(vii) Cleaning

Cleaning that can be safely carried out on this pump is limited. After removal of the baffle or retaining strap only the top jet cap can be removed. Access can still be made to the lower portion of the pump for cleaning purposes which can be carried out by using a bottle brush.

Regular cleaning procedure

(a) Wash the pump interior and components as far as practicable with GENKLENE*, as the top cone (3) and the second-stage ring (2) are a permanent fixture it will be necessary to clean this installation by 'swirling' the solvent around the interior.

(b) Remove all traces of solvent by washing components and the interior as (a) with Acetone, removal of the acetone is by baking to 75°C or by passing warm dry air over the components and interior.

Removal of working fluids

WARNING: Do not expose electrical elements to any solvents or moisture.

Different solvents have to be used to remove working fluids that have been damaged by overheating or by admission of air whilst still at working temperature etc.

(a) L9
To remove L9 it is recommended to use Arklone or Genklene*.

(b) Santovac 5, Arklone or Carbon Tetrachloride (CTC) are best for removing solid black residue since it will dissolve it slowly without heat.

NOTE: Santovac 5 only must be used when testing.

(c) Silicone oils
It is recommended by Dow Corning to use a warm solution (66°C) of 100 parts Dowanol DPM or EB, 100 parts of mineral spirits having a flash point of over 60°C (SCC solvent 140), and one part of Sodium Hydroxide (NaOH).

Rinse with solvent (Dowanol DPM or EB), then rinse thoroughly with clean fresh water. Wipe off excess water and leave unit to dry.

NOTE: Although this solution is non-toxic it is recommended that all relevant safety precautions should be exercised.

(d) Heavy solid deposits
If the pump has a solid deposit of oil around the boiler then pour in the solvent (see c) and switch on the heater for about 5 minutes.

Whilst cooling, occasionally swill the solvent around, during this procedure utmost care must be exercised and the inlet and outlet must be sealed.

(e) If a vapour degreasing bath or an ultrasonic cleaner is available then remove the heater, bottom radiation shield, ceramic insulators, thermal snap switch and fan. Immerse the whole pump in the bath and leave until the oil has been dispensed.

(f) If the aforementioned methods fail to remove residual deposits then the unit must be considered unserviceable and a replacement is recommended.

*GENKLENE (stabilized trichloroethane)
A preferred cleaning solvent for Edwards products - it has a low toxicity and is non-inflammable. However, in common with all highly volatile oil and grease solvents, the major hazard is the narcotic, anaesthetic and toxic effects of breathing in concentrations of vapour resulting from its use in confined spaces. Observe all safety precautions at all times.

Ensure that there is adequate ventilation and rate of air change in the cleansing area.

Smoking must be prohibited.

(viii) Re-assembly

(a) Install the top cap (4) and baffle assembly (6) complete with spring, secure with circlip (7).

(b) Replenish the pump fluid as detailed in 'INSTALLATION'.

(c) Reconnect the pump to the vacuum system and the electrical connexions to the mains supply.

(ix) Renewing the heater

(a) Isolate the pump from the mains electrical supply and disconnect the heater leads at the terminals block.

(b) Remove the four retaining screws then detach the heater shield (9) and conduit adaptor (12).

(c) Remove the spacer (10) then using a suitable brass drift, carefully ease out the cartridge heater (11) from its housing in the pump boiler.

(d) Refer to 'Spares' for details of replacement heater. Prior to assembling the new heater, lightly coat the external surface over the length with anti-seize compound * (NEVERSEEZ' lubricant or equivalent). Insert the heater in the housing and fit the spacer.

CAUTION: Ensure the anti-seize compound does not come in contact with electrical leads or terminals.

(e) Assemble the heater shield and the conduit adaptor and secure the shield with the retaining screws.

(f) Connect the electrical leads to the terminal block and ensure a satisfactory earth connexion is made to the earth screw provided on the heater shield.

*Suppliers: Neverseez Compound Corporation
Broadview
Ilinois, USA

HEALTH/SAFETY ASPECTS - VAPOUR DIFFUSION PUMP FLUIDS

Fluid grade	Product class	Flash Point °C	Auto-ignition point °C (approximate)	Fire Point °C (approximate)
Grade 200	A	192	360	214
Apiezon A		210	370	232
Apiezon B		243	405	263
Apiezon C		246	420	293
Silicone 702	B	193	500	275
Silicone 704/F4		221	500	275
Silicone 705/F5		243	500	275
Santovac 5		288	590	350
L9 Fluid		241	370	281
Apiezon AP301		277	450	305
Fomblin		None	None	None

Edwards recommended vapour diffusion pump fluids are not normally hazardous when used correctly. However, certain hazards may arise due to misuse or accident and the following precautions should be observed to avoid danger to health or safety:

Skin and eye contact

Class A - Mineral oil based fluids are only slightly to moderately irritating to skin and eyes. Prolonged exposure of skin to mineral oils may give rise to dermatitis.

The main precautionary measures entail minimising contact with the skin and the observance of good hygiene. Where skin rashes or other abnormalities occur as a result of prolonged contact with mineral oils, medical advice should be sought immediately.

Protective clothing, regularly laundered overalls and personal clothing plus careful skin cleansing, are all important measures to limit contact. Such measures are detailed in HM Factory Inspectorate Cautionary Notices, SHW 295, Effects on the Skin of Mineral Oil and SHW 397, Effects of Mineral Oil on the Skin.

Class B - These non-petroleum based products are in general only slightly irritant. Prolonged exposure may however, give rise to dermatitis. As with the previous classes of products, the principal precautionary measures are to minimise contact with the skin and observe good hygiene.

Inhalation

Class A - These products do not normally give rise to harmful concentrations of vapour except where high temperature and open systems are involved.

Class B - Edwards recommended products in Class B are particularly inert and are unlikely to give rise to harmful vapours when used in the applications for which they are recommended.

Care should, however, be taken to avoid inhalation of vapours or mists arising from undue heating or excessive mist generation. In the case of fluorinated compounds (eg. Fomblin, Halocarbon) avoid contact with excessive heat (300°C) eg. lighted cigarettes, heater elements, etc.

Ingestion and Aspiration

Ingestion and aspiration of fluids are not regarded as health hazards likely to arise in normal industrial use.

In the unlikely event of accidental ingestion (swallowing), the main hazard is aspiration of liquid into the lungs. Class B products are believed to be of slight to moderate oral toxicity.

Fire Hazards, storage and spillage

These products require no special fire precautions but it is recommended practice to store away from heat. When heat is required to facilitate handling of the product, this should be kept to a minimum.

If the pump operates in close proximity to possible sources of ignition or where oxygen may form a large proportion of the pumped load, then suitable fire-resistant fluids such as Fomblins should be utilised. Fomblins are fully fluourinated perfluoropolyethers and are non-toxic; they are practically inert chemically and have no flash point or fire point.

Fluid spillage should be absorbed with sand, earth or mineral absorbent and disposed of in accordance with the Disposal of Poisonous Wastes Act and Control of Pollution Act 1974.

In the event of large spillages, steps should be taken to prevent pollution of drainage systems, rivers or waterways, or infringement of the above acts.

Edwards

DIFFPUMP E040/55

Used on:-
B30201000 A/C

Fitting Pack B30201048

C10512001	NW1610 clamp
B27158025	Size 10 flange seal pack unit
B27158053	ISO 40 seal pack
C10516001	NW40 clamp
B30201882	Instructions
B30201023	Retaining Bar
B27102014	Spring
H11501022	L9 Oil

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COMMUNICATION WITH EDWARDS

Any communication relating to the subject of this instruction should be addressed to Edwards High Vacuum International or to the supplier from whom it was purchased.

Please specify:

1) the model, serial number and code.

2) the date of purchase.

3) your order number and the suppliers sales reference.

Equipment MUST NOT be returned to the supplier without prior arrangement.

IMPORTANT Health and Safety

Under Section 3 of the Health and Safety at Work Etc Act 1974 every employer has a duty to conduct his business so as not to expose persons not in his employment to risks to their health and safety. When goods are returned to the supplier, therefore, warning must be given if their usage is likely to render the equipment hazardous in any way. Your attention is drawn to FORM HSC001 attached.

Edwards High Vacuum International and its distributors reserve the right to refuse acceptance of any equipment returned which they have reason to believe may be hazardous.

Damage in transit

If any damage has occurred in transit, it is important to inform both the carrier and the supplier within three days of delivery.

wards SERVICE

Edwards High Vacuum
(Part of The BOC Group plc)
W. Sussex RH10 2LW
Tel: 0293 28844
Telex: 87123 edivac g

PROCEDURE FOR RETURNING CONTAMINATED PUMPS TO EDWARDS HIGH VACUUM OR EDWARDS HIGH VACUUM DISTRIBUTOR

n returning a pump to EHV, the following procedure should be wed:

All fluid **must** be drained prior to despatching the pumps.

All pump outlets must be sealed with suitable blanking covers or PVC tape.

All accessories should be removed and if they require servicing, sealed in heavy-duty polythene bags and secured to the pallet with the pump.

Inlet and outer mist filters should be removed. All filter elements **must** be removed and disposed of as contaminated waste.

Any openings left by removing accessories must be sealed with suitable covers or PVC tape.

Pumps and accessories must be sealed in a heavy duty polythene bag and securely strapped to a suitable pallet *(the dimensions of which should not exceed 510mm by 915mm).*

The pallet must be labelled in accordance with current Packaging and Labelling Dangerous Substances regulations 1978 (SI No. 209) and subsequent amendments. At the present time (1985) the following labels should be used:

MAY CONTAIN TOXIC OR CORROSIVE CHEMICALS

8. The Service Department at EHV or EHV Distributor must be notified in writing of the nature of the hazard, the name of the carrier and anticipated delivery date, using Form HSC 001. This should be either Faxed *(Fax No. 0293 33453)* or sent by 1st class post to ensure that we have this information before we receive the equipment.
9. A copy of form HSC 001 should be handed to the carrier who must be informed that the cargo may be contaminated and who should present this copy of HSC 001 with the delivery note at EHV.
10. It is recommended that such pumps should only be transported in vehicles where the driver is in a separate cab, *eg open back lorry.*
11. Failure to comply with this procedure will lead to delays in servicing the equipment.

wards SERVICE

Edwards High Vacuum
(Part of The BOC Group plc)
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Tel: 0293 28844
Telex: 87123 edivac g

HEALTH AND SAFETY CLEARANCE FORM HSC 001

This form must be used when returning pumps and equipment for service at EHV or EHV distributor as per EHV procedure.

A completed copy of this form should be Faxed *(Fax No. 0293 33453)* or sent by 1st class post to ensure that we have this information before we receive the equipment.

A further copy should be handed to the carrier with the equipment.

Failure to complete the form or comply with the procedure will lead to delays in servicing the equipment.

Please complete the following sections:

Pump/Equipment Type .....

Serial No. .....

) Details of all substances pumped.
Chemical names:

(a) .....

(b) .....

(c) .....

(d) .....

2 Precautions to be taken in handling of these substances:

(a) .....

(b) .....

(c) .....

(d) .....

3 Action to be taken in the event of human contact or spillage:

(a) .....

(b) .....

(c) .....

(d) .....

Any further information which you consider relevant:

4.5 Please complete section 4.5.1 if substances are not toxic or hazardous or 4.5.2 if they are.

4.5.1 I hereby confirm that the equipment specified above has **not** pumped or come into contact with any toxic or hazardous substances and that the equipment has been drained of lubricant.

Signed: .....

Name: .....

Position .....

For and on behalf of: .....

Date .....

4.5.2 I hereby confirm that the only toxic or hazardous substances that the equipment specified above has pumped or been in contact with are named above, that the information given is correct and that the following actions have been taken:

1. The equipment has been drained of lubricant.
2. The inlet/outlet ports have been sealed and the equipment has been securely packed and labelled in accordance with EHV procedure.
3. The carrier has been informed of the hazardous nature of the consignment.

Signed: .....

Name: .....

Position: .....

For and on behalf of: .....

Date: .....

4.6 Carrier to be used: .....

Delivery date to EHV: .....

IMPORTANT

Before returning any product for service this form must be completed and sent to the Edwards company or official distributor undertaking the service.

Edwards

International Sales and Service

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Telex 482732 EDVAC D
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